

Add the following new claims:

21. The method of claim 15 and including etching the insulating layer down to the silicon substrate to form the blocking structure.

22. The method of claim 21 and including filling an opening created by the etching step with a sacrificial layer; forming a passivation layer over the sacrificial layer that includes a heater element covered by the passivation layer; forming the bore in the passivation layer; and removing the sacrificial layer.

23. A print head made according to the method of claim 22.

24. A method of forming a continuous ink jet print head having a plurality of nozzles and a bore associated with each nozzle, the method comprising:

providing a semiconductor substrate having integrated circuits for controlling operation of the print head, the substrate having an insulating layer or layers formed thereon, the insulating layer or layers having electrical conductors formed therein that are electrically connected to circuits formed in the substrate;

forming in the insulating layer or layers a secondary ink channel and a blocking structure for controlling lateral flow of ink from a primary ink channel formed in the substrate to a secondary ink channel formed in the insulating layer or layers;

forming a bore communicating with the secondary ink channel; and

forming in the substrate the primary ink channel communicating with the secondary ink channel.

25. The method of claim 24 and including the step of forming a heater element adjacent the bore and forming the bore with a passivation layer covering the heater element.

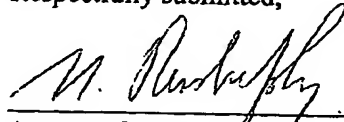
26. The method of claim 25 and including the step of forming a heater element in the insulating layer or layers within the blocking structure to provide a pre-heating element.

27. The method of claim 24 and including etching the insulating layer down to the substrate to form the blocking structure.

28. The method of claim 27 and including filling an opening created by the etching step with a sacrificial layer; forming a passivation layer over the sacrificial layer that includes a heater element covered by the passivation layer; forming the bore in the passivation layer; and removing the sacrificial layer.

29. A print head made according to the method of claim 19.

Respectfully submitted,



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WHAT IS CLAIMED IS:

1. A continuous ink jet print head having a plurality of nozzles, the print head comprising:

a silicon substrate including integrated circuits formed therein for controlling operation of the print head, the silicon substrate having a primary ink channel formed therein;

an insulating layer or layers overlying the silicon substrate, the insulating layer or layers having a secondary channel associated with each nozzle and formed therein and communicating with the primary ink channel;

a bore for each nozzle and formed in a layer or layers overlying the insulating layer or layers and communicating with the secondary channel; and

wherein the insulating layer or layers includes a blocking structure between the primary ink channel and the secondary ink channel, an access being provided between the primary ink channel and the secondary ink channel to permit ink from the primary ink channel to flow about the blocking structure and to enter the secondary ink channel at a location offset from the bore to provide lateral flow components to the liquid ink entering the bore opening.

2. The print head of claim 1 wherein the insulating layer or layers includes a series of vertically separated levels of electrically conductive leads and electrically conductive vias connect at least some of said levels.

3. The print head of claim 1 wherein the bore is formed in a passivation layer and a heater element is covered by the passivation layer.

4. The print head of claim 3 wherein the blocking structure includes a secondary heater element that operates to preheat ink as ink flows between the primary ink channel and the secondary ink channel.

5. The print head of claim 4 wherein the secondary heater element is formed of polysilicon.

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6. The print head of claim 5 wherein the heater element in the passivation layer is formed of TiN.

7. The print head of claim 1 wherein the insulating layer or layers is formed of an oxide.

8. The print head of claim 1 wherein the integrated circuits include CMOS devices.

9. A method of operating a continuous ink jet print head having a plurality of nozzles with each nozzle having a bore, the method comprising:

providing liquid ink under pressure in a primary ink channel formed in a silicon substrate having a series of integrated circuits formed therein for controlling operation of the print head;

causing the ink to flow into a secondary ink channel formed in an insulating layer or layers overlying the silicon substrate;

asymmetrically heating of the ink as it flows around heaters to control the direction of an ink droplet from the nozzle; and

providing lateral flow components to an ink jet or stream that is established by having ink flow about a blocking structure formed in the insulating layer or layers overlying the silicon substrate.

10. The method of claim 9 wherein the integrated circuits include CMOS devices that are used to control a heater formed adjacent the bore.

11. The method of claim 10 wherein the insulating layer or layers include a series of vertically separated levels of electrically conductive leads and electrically conductive vias connect at least some of the levels and signals are transmitted from the CMOS devices formed in the substrate through the electrically conductive vias.

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12. The method of claim 11 wherein the blocking structure includes a secondary heater element that operates to preheat ink as ink flows between the primary ink channel and the secondary ink channel.

13. The method of claim 12 wherein the secondary heater element is formed of polysilicon.

14. The method of claim 9 wherein the blocking structure includes a secondary heater element that operates to preheat ink as ink flows from the primary ink channel to the secondary ink channel.

15. A method of forming a continuous ink jet print head having a plurality of nozzles and a bore associated with each nozzle, the method comprising:

providing a silicon substrate having integrated circuits for controlling operation of the print head, the silicon substrate having an insulating layer or layers formed thereon, the insulating layer or layers having electrical conductors formed therein that are electrically connected to circuits formed in the silicon substrate;

forming in the insulating layer or layers a secondary ink channel and a blocking structure for controlling lateral flow of ink from a primary ink channel formed in the silicon substrate to a secondary ink channel formed in the insulating layer or layers;

forming a bore communicating with the secondary ink channel; and
forming in the silicon substrate the primary ink channel communicating with the secondary ink channel.

16. The method of claim 15 and including the step of forming a heater element adjacent the bore and forming the bore with a passivation layer covering the heater element.

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17. The method of claim 16 and including the step of forming a heater element in the insulating layer or layers within the blocking structure to provide a pre-heating element.

18. The method of claim 15 and including etching the insulating layer down to the silicon substrate to form the blocking structure.

19. The method of claim 18 and including filling an opening created by the etching step with a sacrificial layer; forming a passivation layer over the sacrificial layer that includes a heater element covered by the passivation layer; forming the bore in the passivation layer; and removing the sacrificial layer.

20. A print head made according to the method of claim 19.

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